

App. No. 10/828,944
Amendment Dated October 24, 2006
Reply to Office Action of May 24, 2006

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REMARKS/ARGUMENTS

Claims 1 - 29 are pending in the present application. The Non-Final Office Action, dated May 24, 2006: rejected claims 1 - 29. No new subject matter has been added. Claims 1, 3, 4, 13, 23, 25, 27, 28 and 29 are amended. For at least the following reasons, the Applicant respectfully submit that the pending claims as amended are in condition for allowance, and notice to that effect is requested.

Rejection of claims 1, 2, 9 - 14 and 23 - 28 under 35 U.S.C. § 102(b)

Claims 1, 2, 9 - 14 and 23 - 28 under 35 U.S.C. § 102(b) as being anticipated by *Umminger et al.* (U.S. Patent No. 6,476,589). In particular, the Office Action states that "Umminger discloses a "an inductor (16); switching circuit (13); sense circuit (17); feedback circuit (20,21); comparator circuit (18); one shot circuit (11); n-FET (13); resistance circuit (15; col. 4 line 22); PLL circuit (34)." The following discussion addresses each of the above described features that are recited in Applicant's claims, and how the *Umminger* reference fails to satisfy the limitations sufficient to maintain a rejection under 35 U.S.C. § 102(b).

Claims 1, 13, 23, 25, 27 and 28 have been amended to include further clarification of that which is distinctive in the present disclosure. Claims 2 and 9 - 12 depend upon and further limit claim 1. Claim 14 depends upon and further limits claim 13. Claim 26 depends upon and further limits claim 25. For at least the following reasons, it is believed that amended claims 1, 2, 9 - 14 and 23 - 28 are in proper form for allowance, and a notice of allowance is requested.

Applicant wishes to direct attention to the details of Applicant's FIGS. 2 and 5, which illustrates that which is claimed by amended claims 1, 13, 23, 25, 27 and 28. In particular, please note that the Applicant's sense circuit is coupled to one input of the comparator at a sense

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terminal, while the Applicant's feedback signal is coupled to another input of the comparator at a feedback terminal. It is important to note that the Applicant's reference signal is coupled to the sense terminal and thus included as part of the sense signal. Applicant believes that the present amendment of claims 1, 13, 23, 25, 27 and 28 illustrates these points. Another point of distinction over the prior art is that the Applicant's control scheme is accomplished without an error amplifier and any associated loop filtering/compensation mechanisms. The amended claims reflect these essential differences as follows below.

Applicant's amended claim 1 includes at least the following features not taught, suggested, or otherwise found in the *Umminger* reference or any other cited references:

“a sense circuit that is arranged to provide a sense signal at a sense terminal that is related to a current in the inductor and a reference signal only during a selected operating phase of the converter... wherein the sense signal at the sense terminal corresponds to the reference signal during the non-selected operating phase;

a feedback circuit that is arranged to provide a feedback signal at a feedback terminal in response to an output signal of the converter ... ;

a comparator circuit that includes a first input that is coupled to the feedback terminal, a second input that is coupled to the sense terminal ...; and

... wherein the inductor, the switching circuit, the sense circuit, the feedback circuit, the comparator circuit, and the one shot circuit are arranged such that error amplifier and associated compensation circuits are unnecessary in the switched mode power converter.”

Applicant's amended claim 13 includes at least the following features not taught, suggested, or otherwise found in the *Umminger* reference or any other cited references:

“a sense circuit that is arranged to provide a sense signal at a sense terminal that is related to a current in the inductor and a reference signal during a selected operating

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phase of the converter ... wherein the sense circuit is arranged such that the sense signal corresponds to the reference signal during the non-selected operating phase;

a feedback circuit that is arranged to provide a feedback signal at a feedback terminal in response to an output signal of the converter;

a comparator circuit that includes a first input that is coupled to the feedback terminal, a second input that is coupled to the sense terminal ... ;

... wherein the inductor, the switching circuit, the sense circuit, the feedback circuit, the comparator circuit, and the one shot circuit are arranged such that error amplifier and associated compensation circuits are unnecessary in the switched mode power converter; and

a PLL circuit that is arranged to provide a bias signal based on a comparison between a reference frequency and a feedback frequency that is associated with the control signal."

Applicant's amended claim 25 includes at least the following features not taught, suggested, or otherwise found in the *Umminger* reference or any other cited references:

"... A method for adjusting pulse widths ... in a switched mode power converter that does not use an error amplifier and any associated compensation circuits ...

providing a sense signal at a sense terminal that is related to a current in the inductor and a reference signal only during a selected operating phase of the converter ... wherein the sense signal at the sense terminal corresponds to the reference signal during the non-selected operating phase;

comparing an output signal associated with the load circuit to the sense signal from the sense terminal;

asserting a start signal in response to the comparison when the output signal associated with the load circuit reaches a threshold during the selected operating phase of the converter ...".

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Applicant's amended claim 27 includes at least the following features not taught, suggested, or otherwise found in the *Umminger* reference or any other cited references:

"a sense means for providing a sense signal at a sense terminal that is related to a current in the inductor and a reference signal during a selected operating phase of the converter... wherein the sense signal at the sense terminal corresponds to the reference signal during the non-selected operating phase;

an isolation means that is arranged to isolate the sense means from the inductor during the non-selected operating phase of the converter;

a comparison means for comparing an output signal associated with the load circuit to the sense signal ...

wherein the inductor, the switching means, the sense means, the isolation means, the comparison means, and the pulse means are arranged such that error amplifier and associated compensation circuits are unnecessary in the switched mode power converter."

Applicant's amended claim 28 includes at least the following features not taught, suggested, or otherwise found in the *Umminger* reference or any other cited references:

"a sense circuit that is selectively coupled to the inductor during a selected operating phase of the converter via the switching circuit, and wherein the sense circuit is decoupled from the inductor during the non-selected operating phase of the converter, wherein the sense circuit is arranged to provide a sense signal at a sense terminal that is related to a current in the inductor and a reference signal during the selected operating phase of the converter ... wherein the sense signal at the sense terminal corresponds to the reference signal during the non-selected operating phase;

a feedback circuit that is arranged to provide a feedback signal at a feedback terminal ...

a comparator circuit that includes a first input that is coupled to the feedback terminal, a second input that is coupled to the sense terminal ...

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wherein the inductor, the switching circuit, the sense circuit, the feedback circuit, the comparator circuit, and the one shot circuit are arranged such that error amplifier and associated compensation circuits are unnecessary in the switched mode power converter.”

A claimed difference between the presently claimed invention and the cited prior art, and particularly the *Umminger* reference, is that there is no need for an error amplifier in the Applicant's claimed invention. Error amplifiers add additional gain into the feedback loop that typically require loop compensation networks (aka loop filters) due to the high loop gain that the error amplifier inserts into the control path of the system. The claimed invention as described by claims 1 – 29 has is inherently stable without any need for compensation. From an engineering standpoint, an error amplifier with a fixed compensation network has a number of poles and zeros that vary over various operating conditions, so that the compensation can not typically stabilize all possible operating conditions. The waveforms in Fig 4A illustrate the operational features of the Applicant's claims, where each pulse terminates when the sense signal (e.g., the difference between VREF and ISENSE*RFB) and the feedback signal are equal. Hence in the Applicant's claimed invention there is no error signal that is created by amplifying the difference of Vout and Vref with an error amplifier, which is principally what the *Umminger* reference uses to generate the signal from error amplifier 21 and loop compensation circuit 22. Applicant has thus found a novel solution that eliminates the need for the error amplifier and the associated loop compensation circuits. Another benefit of the Applicant's claimed invention is that the operating speed of the feedback loop is increased since the error amplifier's compensation network typically slows the response in order to increase stability.

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For the reasons stated above, the rejection of Claims 1, 2, 9 – 14 and 23 – 28 under 35 U.S.C. § 102(b) as being anticipated by *Umminger et al.* is believed to be overcome, and a notice of allowance is respectfully requested.

Rejection of claims 3 – 8, 15 – 20, 21 and 29 under 35 U.S.C. § 103(a)

Claims 3 – 8, 20, 21 and 29 are rejected under 35 U.S.C. § 103(a) as being unpatentable over *Umminger et al.* (U.S. Patent No. 6,476,589) in light of *Roman* (U.S. Patent No. 6,204,649).

In particular, the Office Action states that “Umminger discloses a “an inductor (16); switching circuit (13); sense circuit (17); feedback circuit (20,21); comparator circuit (18); one shot circuit (11); n-FET (13); resistance circuit (15; col. 4 line 22); PLL circuit (34).” The Office Action further states that “Roman teaches using an actual resistor to measure the current (128&resistor) of the inductor to generate a control signal used in the control of the switching of the transistors to eliminate noise normally generated from the switching of conventional regulators.” Claims 3 and 4 have been amended to include further clarification that which is distinctive in the present disclosure. Claims 5 – 8 depend upon and further limit claim 4. For at least the following reasons, it is believed that amended claims 3 and 4 are in proper form for allowance, and a notice of allowance is requested for claims 3 – 8.

Claims 15 – 20 are rejected under 35 U.S.C. § 103(a) as being unpatentable over *Umminger* in view of *Voyce* (U.S. Patent No. 4,754,277). Claims 15 – 20 depends from claim 13 via any intervening claims. Since claim 13 is proposed to be allowable, the rejection of those claims under 35 USC § 103(a) is rendered moot and a notice of allowance is requested for claims 15 – 20.

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Claims 20, 21 and 29 are rejected under 35 U.S.C. § 103(a) as being unpatentable over *Umminger* in view of *Roman*. Claims 20 depends from claim 13 via intervening claims, while claim 21 depends from and further limits claim 1. Since claims 1 and 13 are proposed to be allowable, the rejection of those claims under 35 USC § 103(a) is rendered moot. Claim 29 is amended, and believed to be in proper form for allowance for similar reasons as the other claims described above. A notice of allowance is requested for claims 20, 21 and 29.

Applicant's amended claim 3 includes similar features to those described previously above for Applicant's claim 1:

"a sense circuit that is arranged to provide a sense signal at a sense terminal that is related to a current in the inductor and a reference voltage only during a selected operating phase of the converter ... the sense circuit comprising: a resistor circuit that is coupled between a reference terminal and the sense terminal, and a current sense circuit that is coupled to the resistor circuit via the sense terminal ... arranged ... such that the sense signal at the sense terminal corresponds to the difference between the reference voltage and a product of the sense current and the resistance value of the resistor circuit during the selected operating phase, and the sense signal at the sense terminal corresponds to the reference voltage during the non-selected operating phase;

a feedback circuit that is arranged to provide a feedback signal in response to an output signal of the converter at a feedback terminal;

a comparator circuit that includes a first input that is coupled to the feedback terminal, a second input that is coupled to the sense terminal ...;

... wherein the inductor, the switching circuit, the sense circuit, the feedback circuit, the comparator circuit, and the one shot circuit are arranged such that error amplifier and associated compensation circuits are unnecessary in the switched mode power converter."

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Applicant's amended claim 4 includes similar features to those described previously above for Applicant's claim 1:

"a sense circuit that is arranged to provide a sense signal at a sense terminal that is related to a current in the inductor only and a reference voltage during a selected operating phase of the converter ... the sense circuit comprising: a first resistor that is coupled between the switching circuit and a supply terminal, a trans-conductance circuit that is arranged to provide a sense current to the sense terminal in response to a voltage across the first resistor, and a second resistor that is coupled between a reference voltage and the sense terminal such that the sense signal corresponds to a voltage associated with the sense terminal, wherein the sense signal at the sense terminal corresponds to the reference voltage during the non-selected operating phase;

a feedback circuit that is arranged to provide a feedback signal at a feedback terminal in response to an output signal of the converter;

a comparator circuit that includes a first input that is coupled to the feedback terminal, a second input that is coupled to the sense terminal ...

wherein the inductor, the switching circuit, the sense circuit, the feedback circuit, the comparator circuit, and the one shot circuit are arranged such that error amplifier and associated compensation circuits are unnecessary in the switched mode power converter."

Applicant's amended claim 29 includes similar features to those described previously above for Applicant's claim 1:

"a sense circuit ... arranged to provide a sense signal at a sense terminal that is related to a current in the inductor and a reference signal during the selected operating phase of the converter ... wherein the sense signal at the sense terminal corresponds to the reference signal during the non-selected operating phase ...

a feedback circuit that is arranged to provide a feedback signal at a feedback terminal in response to an output signal of the converter;

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a comparator circuit that includes a first input that is coupled to the feedback terminal, a second input that is coupled to the sense terminal ...

... wherein the inductor, the switching circuit, the sense circuit, the diode circuit, the feedback circuit, the comparator circuit, and the one shot circuit are arranged such that error amplifier and associated compensation circuits are unnecessary in the switched mode power converter."

The arguments presented above regarding Applicant's claim 1 are equally applicable to Applicant's claim 3- 8, 15 - 20, 21, and 29. Again, Applicant wishes to direct attention to the details of Applicant's FIGS. 2 and 5, which illustrates that which is claimed by amended claims 3, 4 and 29. In particular, please note that the Applicant's sense circuit is coupled to one input of the comparator at a sense terminal, while the Applicant's feedback signal is coupled to another input of the comparator at a feedback terminal. It is important to note that the Applicant's reference signal is coupled to the sense terminal and thus included as part of the sense signal. Applicant believes that the present amendment of claims 3 and 4 illustrates these points. Another point of distinction over the prior art is that the Applicant's control scheme is accomplished without an error amplifier and any associated loop filtering/compensation mechanisms. The amended claims reflect these essential differences.

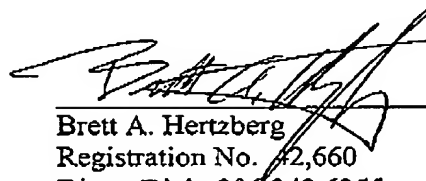
For the reasons stated above, the rejection of Claims 3 - 8, 15 - 20, 21 and 29 under 35 U.S.C. § 103(a) is believed to be overcome, and a notice of allowance is respectfully requested.

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In view of the foregoing amendments and remarks, all pending claims are believed to be allowable and the application is in condition for allowance. Therefore, a Notice of Allowance is respectfully requested. Should the Examiner have any further issues regarding this application, the Examiner is requested to contact the undersigned attorney for the applicant at the telephone number provided below.

Respectfully submitted,

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